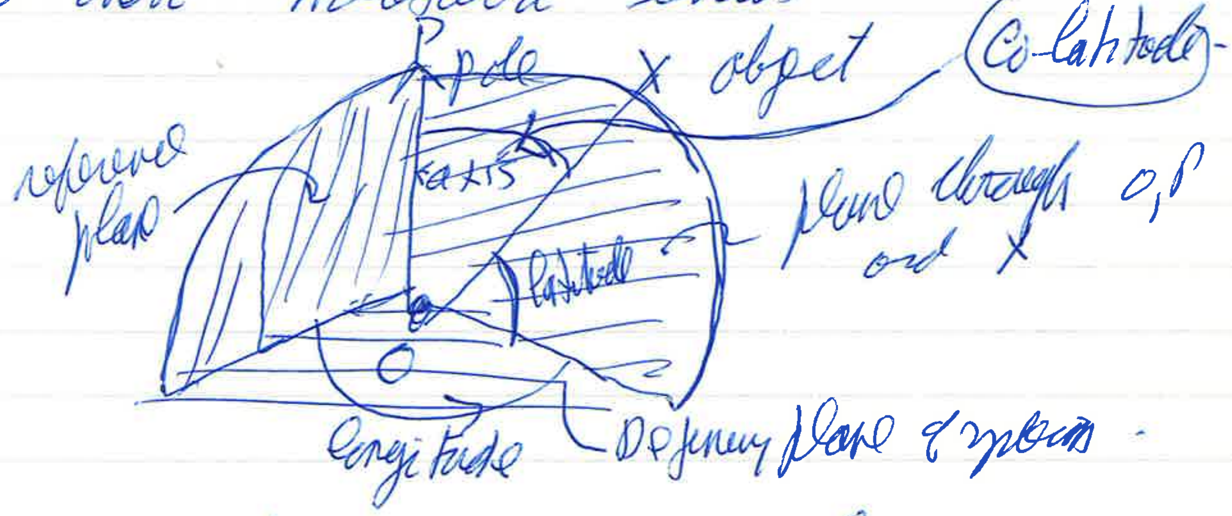
Dear Dr Pratt,

I have given some thought to the Torquetum. The problem is how to use it to measure angular coordinates in the 'horizon', 'equatorial' and 'ecliptic' systems.

In any such ~~us~~ system we have an axis joining the '~~centre~~ observer' of the ~~earth~~ sphere to the appropriate 'pole' P and we have some fixed reference plane through this axis. The angular coords (longitudes, latitude) λ, l of an object X are then measured thus



For our three systems we have.

Pole	~~Horizon~~ System ~~defined by plane of~~	AXIS	Reference plane
Zenith	Horizon	Vertical	~~containing axis and~~ ~~meridian through~~ the ~~[illegible]~~ north pole point.
North ~~Equatorial plane~~ pole.	Equatorial	Spin-axis of earth	~~through~~ to vernal equinox.
Ecliptic pole	Ecliptic	normal to the ecliptic	~~through~~ the vernal equinox.

Longitude	Latitude.
Azimuth	altitude
Right ascension	declination
celestial longitude	celestial latitude.

I shall now refer to the labelled diagram in the printed pamphlet.

To measure ecliptic coordinates (at noon)

Set as a first step circle E in the reference plane defined by the vernal equinox. First set scale B to the correct date (against the zero on A.) then the brass peg on C points to the vernal equinox. Then rotate D to zero on the brass peg on C. E is now in the correct reference plane. Now rotate scale D until we sight up the object X on the sighting arm F. This rotation is the celestial longitude. The reading of F (against E) gives celestial latitude directly.

To measure equatorial coordinates (at noon)

We must first set E in the plane defined by the axes of the equatorial & ecliptic systems. This is done by setting scale D with ~~to reach~~ 90° mark against the brass peg. Now set E in the reference plane through the solstices (not the equinoxes) by rotating B to the correct date as above. Now rotate B through a further angle, say θ, to enable us to sight X. Then the rt. ascension is obtained by adjusting θ by 90°, whilst the declination is read off again from reading of F against E adjusted by 23½°. The whole point is that the declination is obtained by simply adding (or subtracting) the ecliptic obliquity. The

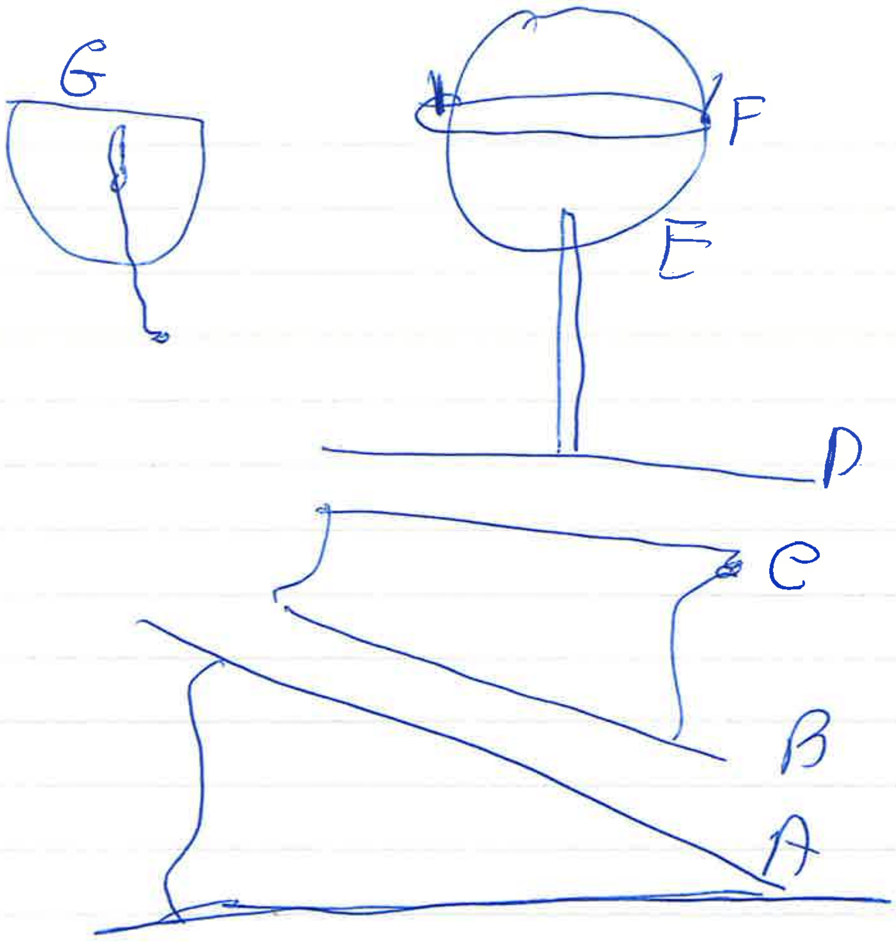
complicated spherical trigonometry is required to calculate the declination from the ecliptic coordinates.

To measure horizon coordinates

This cannot be done with the instrument as described, since it requires rotational capability of the whole apparatus about a vertical axis, with E set in the meridional plane by ~~turning the brass peg at~~ setting the normal equinox on B to the 90° mark on A, the scale D being set ~~as for~~ as described for measuring equatorial coordinates.
The altitude is now obtained by the reading of F against E adjusted by adding (or subtracting) (latitude of observing point) ~~[illegible]~~ (ecliptic obliquity).
Again the measurement of altitude is derived by linear addition or subtraction neglecting the complexities of spherical trigonometry.

However on the instrument you have, it cannot rotate about a vertical axis so azimuth cannot be measured, while altitude is obtained using the device G attached to F.

I haven't had time to check any references in the Literature.
Two used are:
R.T. Gunther: Early Science in Oxford. (1923-1945)
H.M. Michel ~~[illegible]~~ ~~[illegible]~~ Art et Terre (1937 and 1944) (1947)



Torquetum